

Application No. 10/564,735 – Amendment filed December 8, 2008

### **REMARKS**

Claims 1 to 34 remain in the case. Reconsideration in view of the following remarks and entry of the foregoing amendments are respectfully requested.

Claims 1 and 16 have been amended in view of the Office Action and to better define what Applicant considers his invention, as fully supported by an enabling disclosure. In particular, Claims 1 and 16 have been amended to introduce the limitation that conversion of at least one species of PGM into a solid material containing a corresponding PGM chloride salt is induced. Claim 16 has been further amended to introduce the limitation that a gaseous phase containing iron chloride is induced. Support for these amendments can be found, for example, at paragraphs [0017], [0037] and [0064] and [0065] of the description as filed. Dependent claims have been amended to better comply with antecedent rules. Dependent claim 10 has been amended to remove redundancy. No new matter has been entered by the foregoing amendment.

### **REJECTION UNDER 35 U.S.C. § 103**

Claims 1-34 have been rejected under 35 U.S.C. § 103(a) as being obvious in view of International Publication Number 97/46724 by Lalancette *et al.* [hereinafter *the '724 Publication*], Canadian Patent Number 2,193,783 by Lalancette *et al.* [hereinafter *the '783 Patent*], International Publication Number 02/053788 [hereinafter *the '788 Publication*] by Lalancette *et al.*, and “A study of chromite carbochlorination kinetics” by Kanari *et al.* [hereinafter *Kanari*]. Applicant respectfully traverses as follows.

The '724 Publication teaches the chlorination of chromite ores for obtaining chromium enriched chromite. The process comprises the steps of dry chlorinating the ores at a temperature between 400°C and 750°C in the presence of NaCl to produce a chlorinated substrate containing hematite (Fe<sub>2</sub>O<sub>3</sub>) i.e. a solid, and acid insoluble chromium enriched chromite (page 4, lines 1-8; page 11, lines 7-

Application No. 10/564,735 – Amendment filed December 8, 2008

9; and page 12, lines 1-4) . In order to extract the Fe from the hematite, a high amount of hydrochloric acid must be used and the chromium enriched chromite is recovered.

The '783 Patent teaches the chlorination of chromites ore for the extraction of platinum group metal (PGM). The method involves mixing the ore with NaCl 10% wt/wt, dry chlorination of the mixture between 350°C to 800°C with gaseous chlorine thereby producing hematite (i.e. a solid). Extraction of PGM from the hematite is obtained by washing the hematite with a concentrated hydrochloric acid solution, and filtering and recovering the PGM from the solution. PGM recoveries are reported to be in the order of 95 to 100%.

The '788 Publication teaches a method for the recovery of base metals, precious metals, and platinum group metals from fresh ore, mine tailings and industrial wastes. The method comprises the steps of analyzing the ore to determine the presence of one or more of the metals, chloridating the ore with gaseous HCl, separating the solution of metal chlorides from the residue to produce a filtered solution of metal chlorides, recovering the metal chlorides from the filtered solution of metal chlorides to produce a barren solution, and recycling the source of chloride ions. The chloridation process may be carried out in the presence of a near saturated solution of either NaCl, KCl or CaCl<sub>2</sub> or in the presence of about 5% of either solid NaCl, KCl or CaCl<sub>2</sub>.

Kanari, in a study on the formation of gaseous chlorides, demonstrated that some chloride compounds are transported at temperatures where their partial vapour pressure is near zero. In particular, Kanari studied the carbochlorination of a chromite concentrate between 500°C and 1000°C and teaches that chloride compounds can be volatilized at low temperature in the presence of FeCl<sub>3</sub> or AlCl<sub>3</sub>.

Applicant submits that the cited references, taken alone or in combination, fail to teach or suggest a method for recovering at least one PGM species from a feed product, the method comprising mixing the feed with at least one

Application No. 10/564,735 – Amendment filed December 8, 2008

salt so as to produce a mixture and contacting the mixture with gaseous chlorine and CO to induce the conversion of at least one species of PGM into a solid material containing a corresponding PGM chloride salt, as is the case of the present invention as recited at amended Claim 1.

It is first submitted that as indicated in the Application, carbochlorination involving the use of gaseous chlorine in the presence of a reductant such as carbon monoxide; and chlorination involving the use of chlorine without the addition of a reductant agent differ in the chemical reactions that they involve (page 2, paragraph [006]; and page 5, paragraph [0016] of the application).

As seen above, the cited references describe chlorination techniques while the present invention is drawn to a carbochlorination technique. The Applicant thus first submits that a person of ordinary skill in the art would not be led to combine techniques characterized by different chemical reactions since it would not be predictable what chemical reactions would result from such combination.

None of the cited references disclosed or suggested that stable chloride salts could be produced from the various mineralogical forms under which PGM species are found in ores or concentrates (par. [0062]). The present invention is thus the first to show that in the presence of a NaCl-FeCl<sub>3</sub> system, the mineralogical phases carrying the PGM may be converted into a solid material of PGM chloride complexes (paragraphs [0018], [0024] [0029] and [0030]). The addition of NaCl produces PGM chloride salts of the type Na<sub>2</sub>PtCl<sub>6</sub>, NaPdCl<sub>4</sub>, Na<sub>3</sub>RhCl<sub>6</sub>, etc (par. [0060]). Now the formation of PGM chloride salts from PGM species found in ores and concentrates was found to be desirable to avoid the formation of volatile chloride such as PtCl<sub>2</sub> and PdCl<sub>2</sub> and their escape in different process streams (par. [0063]).

The cited references further do not disclose a method comprising inducing a gaseous phase containing iron chloride (FeCl<sub>3</sub>) as is the case of the present invention as recited at amended Claim 16. Inducing the extraction of Fe as

Application No. 10/564,735 – Amendment filed December 8, 2008

gaseous  $\text{FeCl}_3$  advantageously avoids the formation of hematite and the consequent necessary step of leaching with concentrated HCl.

In particular, the '724 Publication teaches chlorinating chromite to obtain a chromium enriched chromite. It does not suggest a method for recovering PGM from chromites. Further, this method for obtaining a chromium enriched chromite comprises a first step of transforming the iron oxide in the chromite into hematite (see page 4, lines 1-8). After this chlorination step, the reactor has to be drained and the hematite dissolved in concentrated hydrochloric acid in order to obtain a residue of enriched chromite (see for example the Abstract of the '724 Publication). The process of the '724 Publication thus necessitates extra processing steps in order to arrive at an enriched chromite, namely the step of dissolving the hematite in concentrated hydrochloric acid. Without the hydrochloric acid, the hematite remains in a solid state.

Similarly, Applicant submits that although the '783 Patent teaches that PGM can be recovered from PGM bearing chromite ores or concentrates by recovering the PGM from a pregnant solution resulting from dry chlorination and containing PGM and a small quantity of other metals, there is no teaching in the '783 Patent of transforming the iron into a gaseous phase containing iron chloride, unlike the present invention as recited at amended Claim 16.

Also, although the '788 Publication teaches PGM recovery from ore using chloridation processes and involves in one embodiment the use of chlorine gas in the presence of a near saturated solution of NaCl, Applicant submits that the '788 Publication mainly focuses on the efficiency of chloridation with a high chloride concentration. See for example page 10 lines 8-9 of the '788 Publication: "(...) the presence of a high chloride concentration is a basic requirement for the implementation of the invention" and page 11 lines 13-15 of the '788 Publication: "The chloridation process while in the presence of a high concentration of chloride ions, offers flexible avenues to the low cost extraction of a wide variety of metals (...)". Applicant however submits that nowhere does the '788 Publication teach the

Application No. 10/564,735 – Amendment filed December 8, 2008

application of such processes to the production and enrichment of chromite products and there is no specific data on PGMs and accordingly no teaching of converting at least one species of PGM into a solid material containing a corresponding PGM chloride salt and a gaseous phase containing iron chloride, unlike the present invention as recited at amended Claims 1 and 16.

In view of the above, Applicant submits that the chlorination techniques taught by the '724 Publication, the '783 Patent and the '788 Publication involve chemical reactions, which differ from those involved in the carbochlorination of the present invention (see for example paragraph [0005] of the description as filed) as recited at amended Claims 1 and 16. In particular, neither of the '724 Publication, the '783 Patent nor the '788 Publication, taken alone or in combination, teach or suggest the fact that the action of chlorine combined with a reductant agent, such as carbon monoxide, results in solid PGM chloride salts. Also, none of the references teach or suggest that carbochlorination is performed with a salt (e.g., NaCl) to produce a catalytic melt when NaCl combines with  $\text{FeCl}_2$  and/or  $\text{FeCl}_3$  so as to increase the volatilization of iron as gaseous  $\text{FeCl}_3$  from the carbochlorination reactor, as is the case of the present invention (see for example paragraph [0069]).

The Examiner further relies on Kanari as teaching the use of carbon monoxide in addition to chlorine. Applicant submits however that Kanari fails to teach or suggest PGM products remaining in a solid phase as a result of the carbochlorination, thus preventing excessive volatilization of PGM species in the  $\text{FeCl}_3$ . Instead, Kanari teaches using carbon monoxide as the reducing atmosphere to permit the volatilization of chlorides leading to a residue rich in chromium compounds (see for example Kanari page 580 column 1 paragraphs 1-2: "This suggest that the carbochlorination of chromite compounds at temperatures close to  $500^\circ\text{C}$  permits the volatilization of these chlorides, leading to a residue rich in chromium compounds"). Applicant thus submits that, prior to the present invention as recited at amended Claims 1 and 16, it was believed that any metals including all PGM species would be volatilized with  $\text{FeCl}_3$  during carbochlorination of chromites and thus would not remain in a solid phase. Moreover, Applicant submits that the

Application No. 10/564,735 – Amendment filed December 8, 2008

study of Kanari focuses on thermodynamic and kinetic considerations and fails to teach how to apply these principles to a method for recovering at least one PGM species from a feed chromite product, in which a catalyst (NaCl) is used to increase the efficiency of the reactions, as is the case of the present invention as recited at Claims 1 and 16.

It would therefore not have been obvious to a person of ordinary skill in the art to modify the teachings of the '724 Publication, the '783 Patent and the '788 Publication with those of Kanari to arrive at the present invention, as recited at amended Claims 1 and 16, where at least one species of PGM is converted into a solid material containing a corresponding PGM chloride salt during the carbochlorination process as such a result was highly unexpected.

In view of the above, Applicant submits that the prior art references fail to teach or suggest all the elements of the present invention as recited at Claims 1 and 16 as amended and that, as such, the claims are not obvious in view of the prior art. Thus, amended Claims 1 and 16 are allowable and as all the remaining objected claims depend from allowable claims, Applicant submits that they, too, are allowable claims.

Applicant would also like to bring to the Examiner's attention that the corresponding granted European case, now issued as European Patent Number 1651785, a copy of which is attached for the Examiner's convenience, was granted with the same set of claims as the one originally submitted. Applicant thus respectfully submits that the amended claims, which are believed to better define what Applicant considers his invention, are allowable.

The foregoing is believed to represent a full response to the Office Action. The application is believed to be in condition for allowance and early and favourable action would be appreciated.

Application No. 10/564,735 – Amendment filed December 8, 2008

**PETITION FOR THREE-MONTH EXTENSION OF TIME**

Applicants hereby request that the period for responding to the Office Action dated June 6, 2008, and originally set to expire September 6, 2008, be extended by three (3) months, so as to expire on December 6, 2008.

The Commissioner is authorized to charge the amount of \$555, to cover the three-month extension herein requested, to Deposit Account No. 07-1509. The Commissioner is further authorized to charge any deficiencies or to credit any overcharges to this same Deposit Account number.

Favourable action on this request for extension of time is courteously solicited.

Authorization is hereby given to charge Deposit Account no. 07-1509 for any deficiencies or overages in connection with this response.

Respectfully submitted,

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